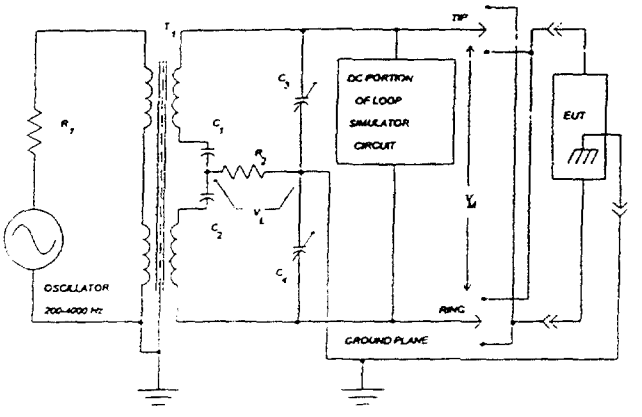
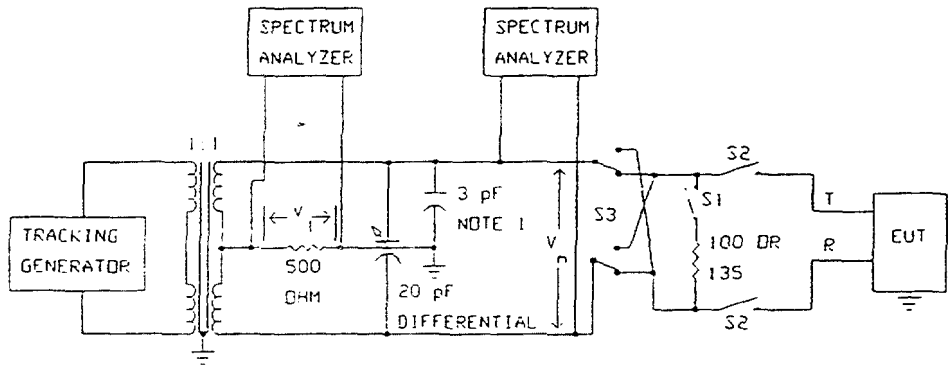


Figure 68.310-1(a)
Illustrative Test Circuit for Transverse Balance (Analog)

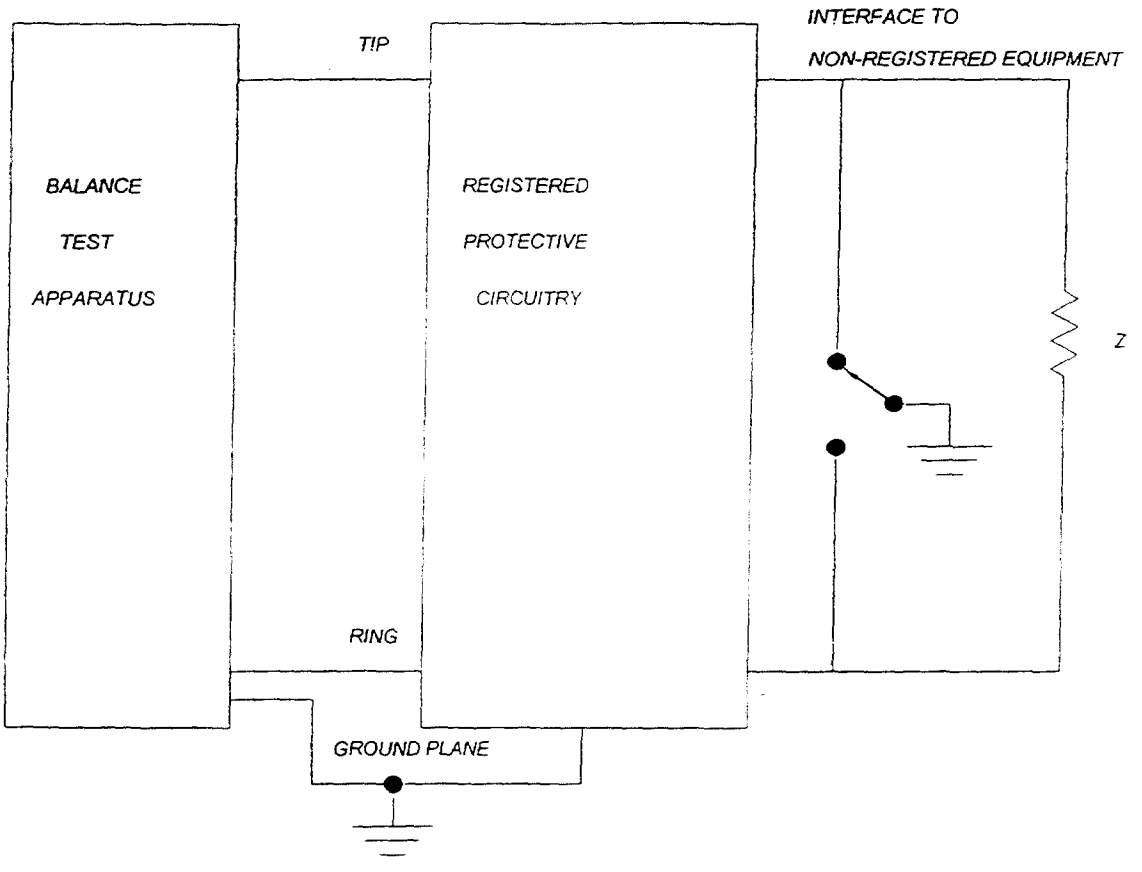
T_1 600 Ω:600 Ω split audio transformer
C_1, C_2 8 μF, 400 V dc, matched to within 0.1 %
C_3, C_4 100 to 500 pF adjustable trimmer capacitors
Osc. Audio oscillator with source resistance R_1 less than or equal to 600 Ohms
R_1 Selected such that $Z_{osc} + R_1 = 600\ \Omega$
R_2 500 Ω

NOTES:
1. V_M should not be measured at the same time as V_L
2. Use trimmer capacitors C_3 and C_4 to balance the test circuit to 20 dB greater balance than the equipment standard for all frequencies specified, with a 600 Ohm resistor substituted for the equipment under test.
3. Exposed conductive surfaces on the exterior of the equipment under test should be connected to the ground plane for this test.
4. When the Terminal Equipment makes provision for an external connection to ground (G), the Terminal Equipment shall be connected to ground. When the Terminal Equipment makes no provision for an external ground, the Terminal Equipment shall be placed on a ground plane which is connected to ground and has overall dimensions at least 50 % greater than the corresponding dimensions of the Terminal Equipment. The Terminal Equipment shall be centrally located on the ground plane without any additional connection to ground.



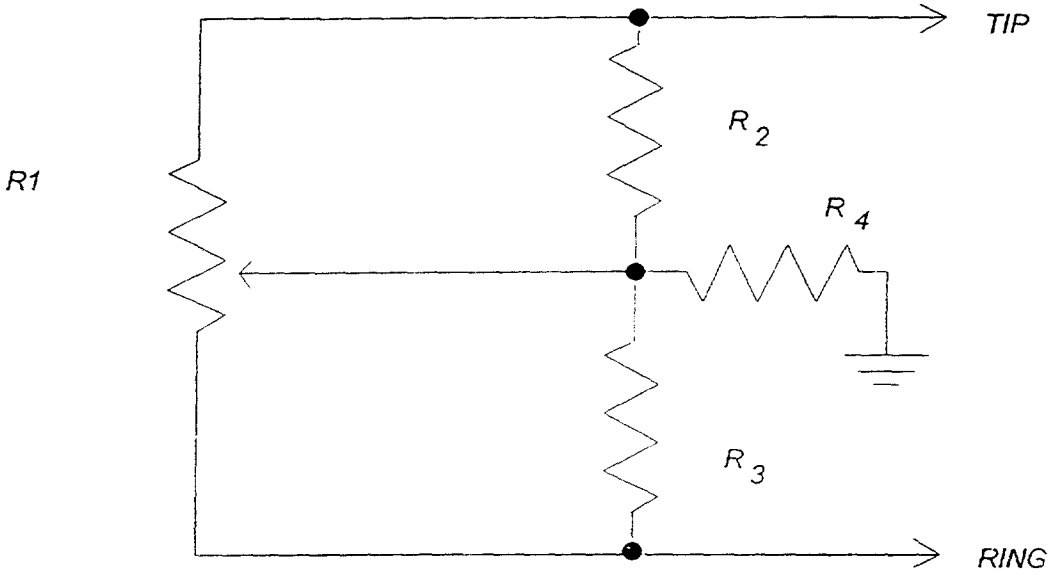
T_1: 100 Ω:100 Ω C.T. wide band transformer
12.4 to 24.5 pF differential trimmer
$R_L Z_1$ from Table 68.310-1
$R_{CAL} Z_0$ from Table 68.310-1
R_1- Selected so that $R_1 + 50\ \Omega = Z_0$ from Table 68.310(a)

Figure 68.310-1(b)
Illustrative Test Circuit for Transverse Balance (Digital)



Z - Selected so that the reflected impedance at tip and ring is 600 Ω, 135 Ω, or 100 Ω depending on the service type of EUT

Figure 68.310(b)
Required Termination for Connections to Non-Registered Equipment



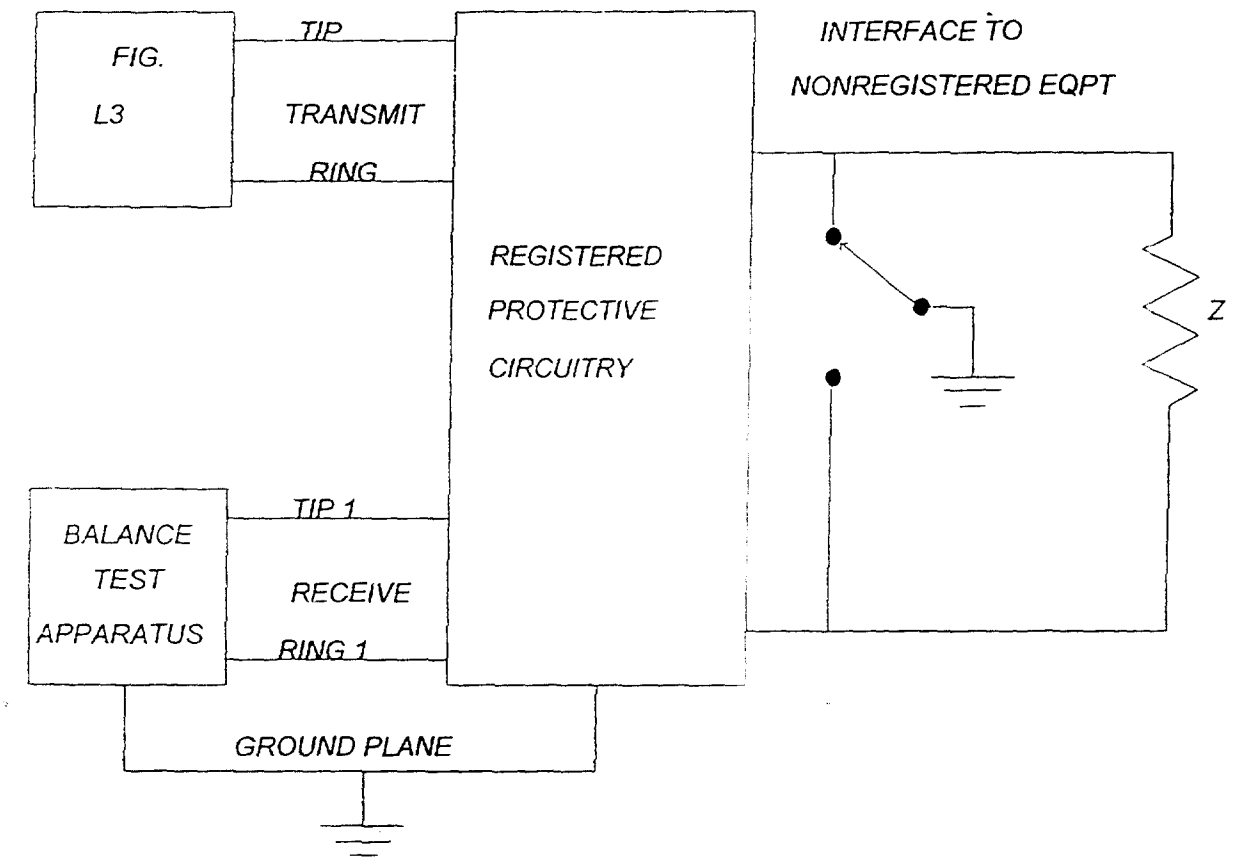
Where: $R_2 = R_3 = 300\ \Omega$, $R_4 = 350\ \Omega$, $R_1 = 300\ k\Omega$, for analog voiceband

$R_2 = R_3 = 67.5\ \Omega$, $R_4 = 56.3\ \Omega$, $R_1 = 100\ k\Omega$, for subrate digital

$R_2 = R_3 = 50\ \Omega$, $R_4 = 65\ \Omega$, $R_1 = 100\ k\Omega$, for 1.544 Mbps

R_1 is used to adjust termination balance. Balance of this termination shall be adjusted to at least 60 dB between 200 and 1000 Hz, and at least 40 dB between 1000 and 4000 Hz, and to at least 35 dB at 1.544 MHz.

Figure 68.310(c)
Off-Hook Termination of Multiport Equipment for Ports Not under Test



Z Selected so that the reflected impedance at tip 1 and ring 1 is 600 Ω, 135 Ω, or 100 Ω depending on service type of EUT.

Configuration shown is for measurement of receive pair.

Figure 68.310(d)
Required Termination for Connections to Non-Registered Equipment

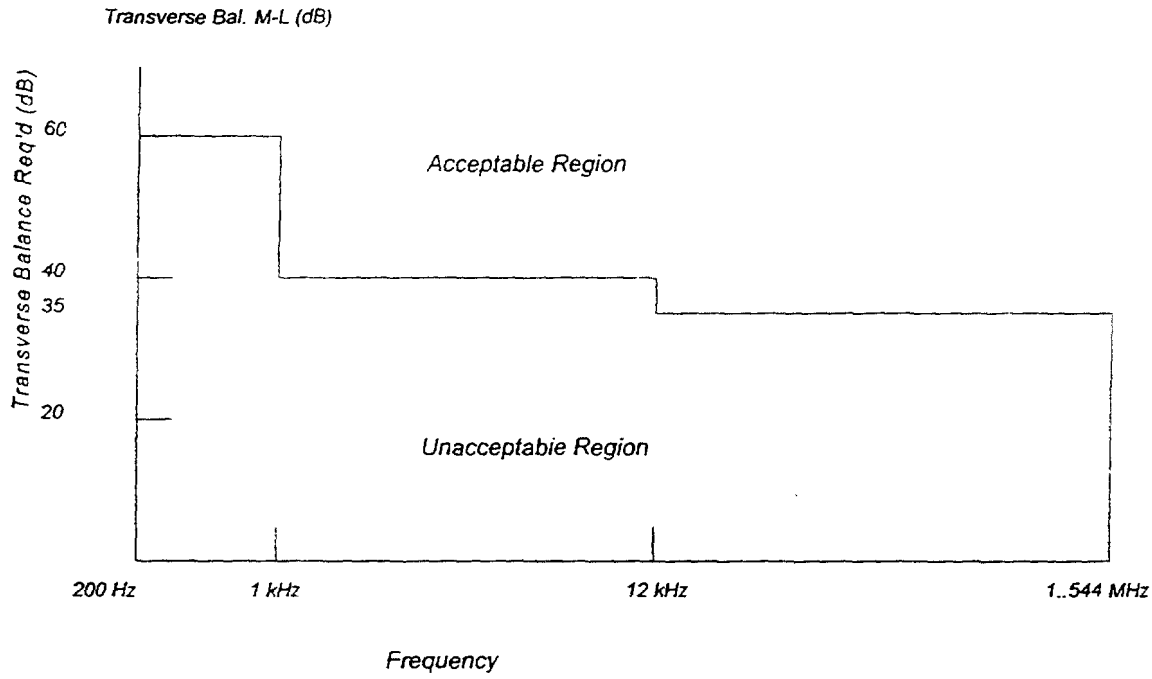


Figure 68.310(e)
Transverse Balance Requirements for Digital Services

§ 68.312 On-hook impedance limitations.

(a) *General.* Requirements in this section apply to the tip and ring conductors of 2-wire interfaces. These requirements also apply to 4-wire loop-start or ground-start interfaces, in the following configuration:

(1) The tip and ring conductors are connected together and treated as one of the conductors of a tip and ring pair.

(2) The tip 1 and ring 1 conductors are connected together and treated as the other conductor of a tip and ring pair.

Throughout this section, references will be made to simulated ringing. Ringing voltages to be used and impedance limitations associated with simulated ringing are shown in Table 68.312(a).

Table 68.312(a)

Ringing Type	Range of compatible ringing frequencies (Hz)	Simulated ringing voltage superimposed on 56.5 volts dc	Impedance limitations (Ohms)
A.....	20 ± 3.....	40 to 130 volts rms	1400
	30 ± 3.....	40 to 130 volts rms	1000
B.....	15.3 to 34	40 to 130 volts rms	1600
	> 34 to 49	62 to 130 volts rms	1600
	≤ 49 to 68	62 to 150 volts rms	1600

(b) *Limitations on individual equipment intended for operation on loop-start telephone facilities.*

(1) Registered terminal equipment and registered protective circuitry shall conform to the following limitations:

(i) *On-hook resistance, metallic and longitudinal (up to 100 Vdc).* The on-hook dc resistance between the tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground, shall be greater than 5 megOhms for all dc voltages up to and including 100 volts.

(ii) *On-hook resistance, metallic and longitudinal (100 V to 200 Vdc).* The on-hook dc resistance between tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground shall be greater than 30 kOhms for all dc voltages between 100 and 200 volts.

(iii) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the total dc current shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(iv) *Ringing frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between the tip and ring conductors (defined as the quotient of applied ac voltage divided by resulting true rms current) shall be greater than or equal to the value specified in Table 68.312(a). The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(v) *Ringing Frequency Impedance (longitudinal).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between each of the tip and ring conductors and ground shall be greater than 100 kOhms. The equipment must comply with each ringing type listed in the ringer equivalence.

(c) *Limitations on individual equipment intended for operation on ground start telephone facilities.* Registered terminal equipment and registered protective circuitry shall conform to the following limitations:.

(1) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total dc current flowing between tip and ring conductors shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type listed as part of the ringer equivalence.

(2) *Ringing frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total impedance of the parallel combination of the ac impedance across tip and ring conductors and the ac impedance from the ring conductor to ground (with ground on the tip conductor) shall be greater than the value specified in Table 68.312(a). The equipment must comply for each ringing type listed as part of the ringer equivalence.

(d) *Ringer Equivalence Definition.* The ringer equivalence number is defined to be the value determined in § 68.312(d)(1) or (d)(2), as appropriate, followed by the ringer type letter indicator representing the frequency range for which the number is valid. If Ringer Equivalence is to be stated for more than one Ringing Type, testing shall be performed at each frequency range to which Ringer Equivalence is to be

determined in accordance with the above, and the largest resulting Ringer Equivalence Number so determined will be associated with each Ringing Type letter designation for which it is valid.

(1) For individual equipment intended for operation on loop-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the minimum measured ac impedance, as defined in paragraph (b)(1)(iv) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(2) For individual equipment intended for operation on ground-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the minimum measured ac impedance, defined in paragraph (c)(2) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(e) *Ringer Equivalence Number labeling.* Registered terminal equipment and registered protective circuitry shall have at least one Ringer Equivalence Number shown on the registration label. Where options that will vary the Ringer Equivalence are involved, either each option that results in a Ringer Equivalence Number greater than 0.1 and its corresponding Ringer Equivalence shall be listed on the registration label, or the largest Ringer Equivalence Number that can result from such options shall be stated on the label. A trained, authorized agent of the Grantee may disconnect ringers, bridge ringers to another line, or execute options affecting Ringer Equivalence after the telephone company has been notified in accordance with § 68.106.

(f) *Maximum Ringer Equivalence.* All registered terminal equipment and registered protective circuitry which can affect the ringing frequency impedance shall be assigned a Ringer Equivalence. The sum of all such Ringer Equivalences on a given telephone line or loop shall not exceed 5. In some cases, a system which has a total Ringer Equivalence of 5 or less may not be usable on a given telephone line or loop.

(g) *OPS interfaces for PBX with DID (Ring trip requirement).* PBX ringing supplies whose output appears on the off-premises interface leads shall not trip when connected to the following tip-to-ring impedance which terminates the off-premises station loop: A terminating impedance composed of the parallel combination of a 15 kOhms resistor and an RC series circuit (resistor and capacitor) whose ac impedance is as specified in Table 68.312(b) below.

Table 68.312(b)

Ringing freq Hz	ac impedance Ohms	
	Class B or C	Class A
20 ± 3	7000/N	1400
30 ± 3	5000/N	1000

N - Number of ringer equivalences, as specified by the manufacturer, which can be connected to the off-premises station loop.

(h) *Type Z Ringers.* Equipment which has on-hook impedance characteristics which do not conform to the requirements of this section may be conditionally registered, notwithstanding the requirements of this section, provided that it is labelled with a Ringing Type designation "Z". It should be noted that registration of equipment bearing the designation "Z" does not necessarily confer any right of connection to the telephone network under these rules. Any equipment registered with the type Z designation may only be used with the consent of the local telephone company, provided that the local telephone company does not discriminate in its treatment of equipment bearing the type Z designation.

(i) *Transitioning to the Off-Hook State.* Registered terminal equipment and registered protective circuitry shall not by design leave the on-hook state by operations performed on tip and ring leads for any other purpose than to request service or answer an incoming call, except that terminal equipment which the user places in the off-hook state for the purpose of manually placing telephone numbers in internal memory for subsequent automatic or repertory dialing shall be registerable. Make-busy indications shall be transmitted by the use of make-busy leads only as defined in § 68.3 and § 68.200(j).

§ 68.314 Billing protection.

(a) *Call duration requirements on data equipment connected to the Public Switched Network, or to Tie Trunks, or to Private lines that access the Public Switched Network.* Registered data terminal equipment and registered protective circuitry shall comply with the following requirements when answering an incoming call, except in off-hook states in which the signals are transmitted and/or received by electroacoustic transducers only.

NOTE: Section 68.314(a) is applicable to terminal equipment and registered

protective circuitry employed with digital services where such digital services are interconnected with the analog telephone network.

(1) *Registered Protective Circuitry.* Registered protective circuitry connected to associated data equipment shall assure that the following signal power limitations are met for at least the first 2 seconds after the off-hook condition is presented to the telephone network in response to an incoming call:

(i) Signals that appear at the protective circuitry/telephone network interface for delivery to the telephone network shall be limited to -55 dBm, (at any frequency in the range of 200 to 3200 Hertz), as such signals are delivered into a loop simulator circuit or a 600 Ohm termination, as appropriate; and

(ii) Signals that appear at the protective circuitry-associated data equipment interface for delivery to associated data equipment shall be limited as follows: for any received signal power (appearing at the protective circuitry-telephone network interface) up to 0 dB with respect to one milliwatt (at any frequency in the range of 200 to 3200 Hertz), the power of signals delivered to associated data equipment shall be no greater than the signal power that would be delivered as a result of received signal power of -55 dBm.

(2) *Registered Terminal Equipment.* Registered terminal equipment for data applications shall assure that, when an incoming telephone call is answered, the answering terminal equipment prevents both transmission and reception of data for at least the first two seconds after the answering terminal equipment transfers to the off-hook condition. For the purpose of this requirement, a fixed sequence of signals that is transmitted (and originated within) and/or received by the registered terminal equipment each time it answers an incoming call shall not be considered data, provided that such signals are for one or more of the following purposes:

(i) Disabling echo control devices,

(ii) Adjusting automatic equalizers and gain controls,

(iii) Establishing synchronization, or

(iv) Signaling the presence and if required, the mode of operation, of the data terminal at the remote end of a connection.

(b) *Voice and data equipment on-hook signal requirements for equipment connected to the Public Switched Network, or to Tie Trunks, or to Private Lines that Access the Public Switched Network.* Registered protective circuitry and registered terminal equipment shall comply with the following:

(1) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator or into a 600 Ohm termination (where appropriate) in the on-hook state, by loop-start or ground-start equipment shall not exceed - 55 dBm within the voiceband. Registered protective circuitry shall also assure that for any input level up to 10 dB above the overload point, the power to a 2-wire loop simulator circuit or the transmit and receive pairs of a 4-wire loop simulator circuit or into a 600 Ohm termination (where appropriate) does not exceed the above limits.

(2) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator circuit, in the on-hook state, by reverse battery equipment shall not exceed -55 dBm, unless the equipment is arranged to inhibit incoming signals.

(c) *Voice and data equipment loop current requirements for equipment connected to the Public Switched network.* The loop current through registered terminal equipment or registered protective circuitry, when connected to a 2-wire or 4-wire loop simulator circuit with the 600 Ohm resistor and 500 microfarad capacitor of the 2-wire loop simulator circuit or both pairs of the 4-wire loop simulator circuit disconnected shall, for at least 5 seconds after the equipment goes to the off-hook state which would occur when answering an incoming call:

(1) Be at least as great as the current obtained in the same loop simulator circuit with minimum battery voltage and a maximum loop resistance when a 200 Ohm resistance connected across the tip and ring of the 2-wire loop simulator circuit or connected across the tip/ring and tip 1/ring1 conductors (tip and ring connected together and tip 1 and ring 1 connected together) of the 4-wire loop simulator circuit in place of the registered terminal equipment or registered protective circuitry; or

(2) Not decreased by more than 25 percent from its maximum value attained during this 5-second interval; unless the equipment is returned to the on-hook state during the above 5 second interval; or

(3) The above requirements also apply in the hold state.

(d) *Signaling interference requirements.*

(1) The signal power delivered to the network interface by the terminal equipment and from signal sources internal to network protection devices in the 2450 Hz to 2750 Hz band shall be less than or equal to the power present simultaneously in the 800 Hz to 2450 Hz band for the first 2 seconds after going to the off-hook state.

(2) Registered terminal equipment for connection to subrate or 1.544 Mbps digital services shall not deliver digital signals to the telephone network with encoded analog content energy in the 2450 to 2750 Hertz band unless at least an equal amount

of encoded analog energy is present in the 800 to 2450 Hertz band for the first two seconds after going to the off hook state.

(e) *On-Hook Requirements for registered terminal equipment for connection to subrate and 1.544 Mbps digital services.* Registered terminal equipment and registered protective circuitry shall comply with the following:

(1) The power delivered to the telephone network in the on-hook state as derived by a zero level decoder shall not exceed -55 dBm equivalent power for digital signals within the voiceband.

(2) Registered protective circuitry shall also assure that the power to a zero level decoder does not exceed the above limits for any input level up to 10 dB above the overload point.

(3) Reverse battery interface. The power derived by a zero level decoder, in the on-hook state, by reverse battery equipment, shall not exceed -55 dBm, unless the equipment is arranged to inhibit incoming signals.

(f) *Off Hook Requirements.* Off-hook signal requirements for registered terminal equipment connecting to 1.544 Mbps digital services. Upon entering the normal off-hook state, in response to alerting, for subrate channels, registered terminal equipment shall continue to transmit the signaling bit sequence representing the off-hook state for 5 seconds, unless the equipment is returned to the on-hook state during the above 5-second interval.

(g) *Operating Requirements for Direct Inward Dialing.*

(1) For registered terminal equipment, the off-hook state shall be applied within 0.5 seconds of the time that:

(i) The terminal equipment permits the acceptance of further digits that may be used to route the incoming call to another destination.

(ii) The terminal equipment transmits signals towards the calling party, except for the call progress tones , i.e., busy, reorder and audible ring, and the call is:

(A) Answered by the called, or another station;

(B) Answered by the attendant;

(C) Routed to a customer controlled or defined recorded announcement, except for "number invalid," "not in service" or "not assigned;"

(D) Routed to a dial prompt; or

(E) Routed back to the public switched telephone network or other destination and the call is answered. If the status of the answered call cannot be reliably determined by the terminal equipment through means such as, detection of answer supervision or voice energy, removal of audible ring, etc., the off-hook state shall be applied after an interval of not more than 20 seconds from the time of such routing.

The off-hook state shall be maintained for the duration of the call.

(2) For registered protective circuitry:

(i) Registered protective circuitry shall block transmission incoming from the network until an off-hook signal is received from the terminal equipment.

(ii) Registered protective circuitry shall provide an off-hook signal within 0.5 s following the receipt of an off-hook signal from the terminal equipment and shall maintain this off-hook signal for the duration of the call.

§ 68.316 Hearing aid compatibility technical requirements.

No change

§ 68.318 Additional limitations.

(a) *General.* Registered terminal equipment for connection to those services discussed below must incorporate the specified features.

(b) *Registered terminal equipment for automatic dialing.*

(1) Automatic dialing to any individual number is limited to two successive attempts. Automatic dialing equipment which employ means for detecting both busy and reorder signals shall be permitted an additional 13 attempts if a busy or reorder signal is encountered on each attempt. The dialer shall be unable to re-attempt a call to the same number for at least 60 minutes following either the second or fifteenth successive attempt, whichever applies, unless the dialer is reactivated by either manual or external means. This rule does not apply to manually activated dialers which dial a number once following each activation.

NOTE: Emergency alarm dialers and dialers under external computer control are exempt from these requirements.

(2) If means are employed for detecting both busy and reorder signals, the

automatic dialing equipment shall return to its on-hook state within 15 seconds after detection of a busy or reorder signal.

(3) If the called party does not answer, the automatic dialer shall return to the on-hook state within 60 s of completion of dialing.

(4) If the called party answers, and the calling equipment does not detect a compatible terminal equipment at the called end, then the automatic dialing equipment shall be limited to one additional call which is answered. The automatic dialing equipment shall comply with (1), (2), and (3) for additional call attempts that are not answered.

(5) Sequential dialers shall dial only once to any individual number before proceeding to dial another number.

(6) Network addressing signals shall be transmitted no earlier than:

(i) 70 ms after receipt of dial tone at the network demarcation point;

OR

(ii) 600 ms after automatically going off-hook (for single line equipment that does not use dial tone detectors);

OR

(iii) 70 ms after receipt of CO ground start at the network demarcation point.

(c) *Line seizure by automatic telephone dialing systems.* Automatic telephone dialing systems which deliver a recorded message to the called party must release the called party's telephone line within 5 seconds of the time notification is transmitted to the system that the called party has hung up, to allow the called party's line to be used to make or receive other calls.

(d) *Telephone Facsimile Machines; Identification of the sender of the message.* It shall be unlawful for any person within the United States to use a computer or other electronic device to send any message via a telephone facsimile machine unless such message clearly contains, in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual. Telephone facsimile machines manufactured on and after December 20, 1992 must clearly mark such identifying information on each transmitted message.

(e) *Requirement that registered equipment allow access to common carriers .*

Any equipment or software manufactured or imported on or after April 17, 1992, and installed by any aggregator shall be technologically capable of providing consumers with access to interstate providers of operator services through the use of equal access codes. The terms used in this paragraph shall have meanings defined in § 64.708 of this chapter (47 CFR 64.708).

§ 68.3 Definitions:

Capture Level: Equipment with AGC (Automatic Gain Control) signal power limiting has virtually no output signal for input levels below a certain value. At some input signal power, the output level will become significant (usually corresponding to the expected output level for service application. The input level at which this occurs is defined as the "capture level". The "overload" point of the equipment is the value of the input level that is 15 dB greater than the capture level.

Overload Point: (1) For signal power limiting circuits incorporating automatic gain control method, the "overload point" is the value of the input signal that is 15 dB greater than the capture level. (2) For signal power limiting circuits incorporating peak limiting method, the "overload point" is defined as the input level at which the equipment's through gain decreases by 0.4 dB from its nominal constant gain.

DTMF: DTMF network control signalling is a method of signalling using the voice transmission path. The method employs sixteen (16) distinct signals each composed of two (2) voiceband frequencies, one from each of two (2) geometrically spaced groups designated "low group" and "high group". The selected spacing assures that no two frequencies of any group combination are harmonically related.

Voiceband: The voiceband for analog interfaces is the frequency band from 200 Hz to 3995 Hz.

Zero Level Decoder: The zero level decoder shall comply with the u=255 PCM encoding law as specified in ITU-TSS (CCITT) Rec. G.711 for voiceband encoding and decoding.